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ABSTRACT

The purposes of this conference panel were to suggest ways of bringing basic and applied research on reading comprehension into an interaction that would enhance both theory and practice, and to develop an approach to the design and study of instructional practice that would maximize the relevance of instructional research for both the public and the education profession. This panel report consists of outlines of three approaches to research and development in reading comprehension. These approaches involve instructional implications of current theories on language comprehension, instructional practice as the source of instructional design and theoretical model building, and psychological analysis of reading comprehension tasks. (JM)

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CONFERENCE ON STUDIES IN READING

"It was unlawful, as well as unsafe, to teach a slave to read.

'It will forever unfit him to be a slave. He will at once become unmanageable and of no value to his master.'

These words sank deep into my heart. From that moment, I understood the pathway from slavery to freedom. Though conscious of the difficulty of learning without a teacher, I set out with high hope and fixed purpose, at whatever cost of trouble, to learn how to read."

Frederick Douglass

NATIONAL INSTITUTE OF EDUCATION

Washington, D.C.
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JUNE, 1975

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PANEL 6

APPLICATIONS OF EXISTING READING COMPREHENSION RESEARCH

PROBLEM STATEMENT

Develop instructional applications of the existing knowledge base in the area of reading comprehension.

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PANEL 6

APPLICATIONS OF EXISTING READING COMPREHENSION RESEARCH

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PREFACE

The National Institute of Education (NIE) came into being during 1972. Its authorizing legislation requires the NIE to:

- Help solve or alleviate the problems of, and achieve the objectives of, American Education.
- Advance the practice of education as an art, science, and profession.
- Strengthen the scientific and technological foundations of education.
- Build an effective education research and development system.

In order to aid in meeting these general objectives, the National Council on Education Research (NIE's policymaking body) approved the creation of five priority programs in December, 1973. One of the priority programs was Essential Skills.* Its purpose was:

> To investigate through research and development, ways to aid all children to obtain skills essential for functioning adequately in school and society.

The initial focus of the Essential Skills Program was in the area of reading. Broad guidelines for an NIE effort in reading had been developed in a small conference held on Cape Cod during the late summer of 1973.** During 1974, the Essential Skills Program carried out an intensive effort designed to formulate more specific plans for funding research and development activities in reading. A variety of meetings were held with groups of teachers, school administrators, and scientists to designate directions for the program. The most ambitious of the meetings was held in Washington, D.C., in August, 1974, and directly involved over 175 individuals -- 50 as Conference participants and 125 as consultants to the Conference. This report is the product of one of the 10 panels of the August Conference.

The impetus for the Conference stemmed from a number of concerns about the state of Federal funding of research and development in education. Four concerns stood out in particular for reading.

1. Research in the field of reading was fragmented and noncumulative.

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*During the past four months, the Essential Skills Program has been renamed the Learning Division of the Basic Skills Group. Both the Basic Skills Group and the Learning Division continue to follow the guidelines set out by the National Council in December, 1973 (above).

**See Miller, George A. (ed.) Linguistic Communication: Perspective for Research, International Reading Association; Newark, Delaware, 1974, 45 pp.

2. The Federal Government was not making constructive use of the state of knowledge in the field in their decisions to fund new research and development.

3. There was a lack of positive and firm coordination between the Federal Government and the professional research and practitioner organizations around the country.

4. A large number of scientists in a variety of disciplines carry out research with relevance to reading. We considered it important to attract these scientists to work in the applied areas of educational research.

The Conference itself was a step in meeting these concerns. During the past year, the NIE has been developing plans for funding research and development in reading for the next two years. Suggestions from the Conference have played an important role in this process. But planning is an ongoing process and we hope by publishing and widely disseminating the reports from the Conference to stimulate discussion of the reports, of research and development in the field of reading, and, indirectly, of the plans of the Institute.

To some extent the format for the Conference was influenced by three other similar efforts of the Federal Government. In the area of health research, the conferences leading to the National Cancer Plan and the National Heart and Lung Institute Plan served as partial models. Within NIE, the Teaching Division had held a major planning effort in the area of teaching research during the early summer of 1974. The intent in each of these efforts was to develop a coherent set of documents that would be responsive to the needs of the American public and to knowledge in the field.

We felt it necessary to structure the Conference in two important ways. First, after extensive consultation with scientists and practitioners in the field we arrived at the conclusion that major efforts in the past had often ignored or down-played the critical importance of the stage of reading called "reading comprehension." Although we realized the impossibility of actually separating out "reading comprehension" from the earlier stage of learning to read -- which requires the learner to be able to translate written letters and words into speech -- our advice suggested that the comprehension or "reading for meaning" stage required far more attention than it had received in the past. Consequently, seven of the ten panels focused on problems in this area. Second, to direct the focus of the panels to planning future research we requested the panelists to organize their ideas into general approaches within the problem area, within the approaches to suggest programs for research, and, finally, when possible to specify particular research or development projects.

The seven panels addressing problems in comprehension spanned a wide range of concerns. The first three panels focused on basic research issues. Their panel reports are titled: Semantics, Concepts, and Culture; The Structure and Use of Language; and Attention and Motivation. The fourth panel was asked to consider the problem of Modeling the Reading Process. The fifth panel directed its attention to the issue of measuring how well people read and its report is titled Assessment of Reading Comprehension. The sixth and seventh reports directed themselves respectively at the practical problems of the Application of Existing Reading Comprehension Research and Reading Comprehension and the High School Graduate. The final three panels directed their attention to three pressing concerns in early reading: Learning and Motivation in Early Reading; Reading Strategies for Different Cultural and Linguistic Groups; and Essential Skills and Skill Hierarchies in Reading.

Although the reports have undergone some revision and editing since the Conference, the major part of the work was done in concentrated sessions in the space of a few days. The resulting documents are not polished or exhaustive. They are meant to be working documents to stimulate debate, suggestions, and comments. Such comments or requests for other reports should be directed to:

Director, Learning Division
National Institute of Education
Washington, D.C. 20208

The work of organizing the Conference was carried out by members of the Essential Skills staff at the NIE -- each of the panels had an NIE staff person as a permanent liaison. Special acknowledgments are due to Susan Duffy and Donald Fisher for their assistance in preparing the reports for publication and to Arthur Young & Company for coordination and arrangements before, during, and after the Conference. Finally, the work of NIE cannot proceed without the kind of skill, involvement, and hard work given by the panel chairpeople, panelists, and consultants for this Conference. The ideas and emphases in the reports are the products of their cumulative expertise.

Marshall S. Smith
Conference Chairperson

LIST OF PANEL REPORTS AND CHAIRPERSONS

1. Semantics, Concepts, and Culture, Dr. George Miller, Rockefeller University

2. The Structure and Use of Language, Dr. Thomas Trabasso, Princeton University

3. Attention and Motivation, Dr. Sheldon White, Harvard University

4. Modeling the Reading Process, Dr. Richard Venezky, Wisconsin University

5. Assessment of Reading Comprehension, Dr. Ernst Rothkopf, Bell Laboratories

6. Application of Existing Reading Comprehension Research, Dr. Lauren Resnick, University of Pittsburgh

7. Reading Comprehension and the High School Graduate, Dr. Mina Shaugnessy, City University of New York

8. Learning and Motivation in Early Reading, Dr. Richard Hodges, University of Chicago

9. Reading Strategies for Different Cultural and Linguistic Groups, Dr. Manuel Ramirez, University of California, Santa Cruz

10. Essential Skills and Skill Hierarchies in Reading, Dr. Irene Athey, University of Rochester

PANEL 6

APPLICATIONS OF EXISTING READING COMPREHENSION RESEARCH

INTRODUCTION

This panel's concern was to suggest ways of bringing basic and applied research on reading comprehension into an interaction that would enhance both theory and practice. Further, the panel was concerned with developing an approach to the design and study of instructional practice that would maximize the relevance of instructional research to the needs, interests, and preferences of the public and the education profession.

It is typically the scientists' stance to withhold policy judgment, to claim that we need more knowledge before we can make any proposals for action. On the other hand, people concerned with meeting immediate and pressing social problems are often impatient of delay, and demand quick and practical programs for widespread use. Each of these approaches poses difficulties. Continual delay of proposals for instructional practice has the effect of sacrificing scientific influence on education. On the other hand, indiscriminate demand for immediate action invites an endless cycle of innovation for its own sake, and a loss of the possibility for building a firm base of principles from which to derive instructional practice. In seeking to develop applications of existing knowledge, this panel tried to avoid the temptations of both of these stances taken as extremes. In so doing, it sought means of mitigating the traditional separation of science and practice, and of thereby bringing about a convergence on an important social problem.

Two sets of interactions seemed to us important to productive research and practice. One is the broad interaction between the research community and the public's expectations for its schools. At the center of this interaction are those responsible for the practice and governance of education. These people look to the research community for assistance in responding to public expectations. For this response to happen most effectively, we must conduct research that draws its questions both from extant theory and from educational needs as defined by society.

The second interaction, more specific, concerns the relationship between the current knowledge base and ongoing instructional experimentation. Research in education should, ideally, yield both usable teaching techniques and data that clarify basic theory. Thus, existing knowledge is "applied" and from the application new questions generated. The process envisioned is iterative and responsive both to changes in the knowledge base and to changes in the schools' demands for useful instructional products and processes.

The proposals that follow are concerned with individuals who have mastered the beginning stages of reading. We assume that the target population has a substantial reading vocabulary and a set of usable strategies for decoding printed words. Moreover we have focused on the comprehension of written materials in the language in which the speaker is already orally fluent. We are not directly concerned with the problems of comprehending second languages, and we give no attention to

dialect differences on the assumption that users of various American dialects are also fluent in understanding "standard" spoken English. Where this assumption does not hold, the proposals may need modification, or they may be inapplicable.

We propose three approaches to research and development in reading comprehension. They are intended to converge in such a way as to lead to improved instructional practice, well-grounded in theoretical terms, and at the same time, to contribute to a refinement of theory on the basis of instructional experimentation. The first approach begins with a distillation of current theory concerning the way people comprehend language. It attempts to derive from this comprehension suggestions for instructional practice. This is the classical way of looking at the question of "applying" basic knowledge. The second approach begins with an analysis of classroom practice and seeks a formulation of underlying principles that account for success in what appears on the surface to be divergent practice. It recognizes the practicing teacher as a potential source of information, both for an organized theory of the acquisition of reading competence and for aiding other practitioners. The third approach begins with the identification of actual reading tasks and the psychological analysis of those tasks in order to discover the basic processes involved. This approach both suggests instructional practice and constitutes a special form of psychological research in which instructional experimentation elucidates basic theory.

Figure 1, following this page, displays the three major approaches proposed and the intended relationships among them.

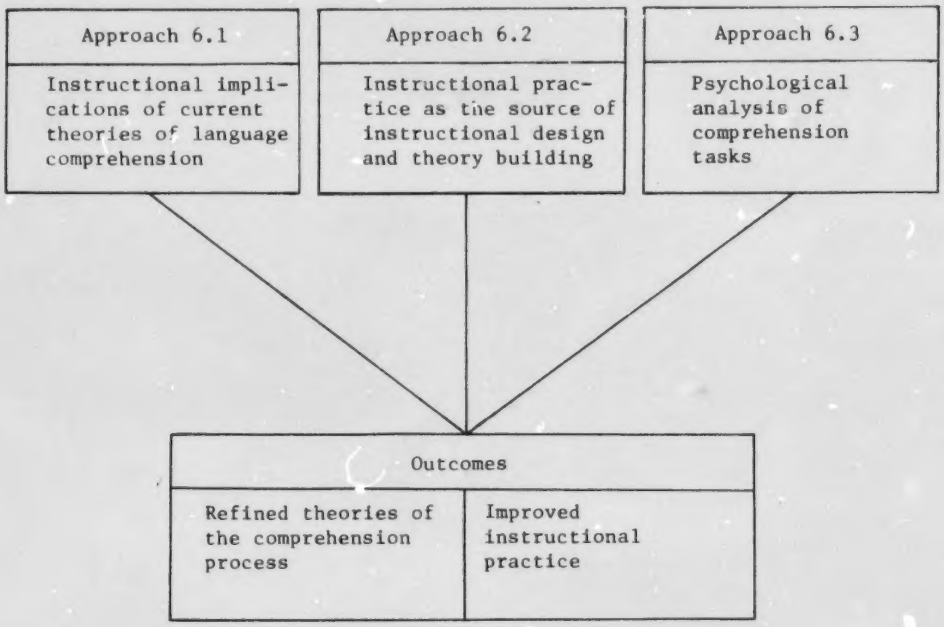
Approach 6.1
Instructional implications of current theories of language comprehension
Approach 6.2
Instructional practice as the source of instructional design and theory building
Approach 6.3
Psychological analysis of comprehension tasks
Outcomes
Refined theories of the comprehension process
Improved instructional practice

Figure 1: Approaches to the Study of Reading Comprehension and their Outcomes

APPROACH 6.1

INSTRUCTIONAL IMPLICATIONS OF CURRENT THEORIES OF LANGUAGE COMPREHENSION

Research on natural language comprehension has mushroomed in the past few years. Whereas a decade ago psychologists would have been hard pressed to offer strong hypotheses about how people understood language, today we have a number of theories and growing amounts of data to call upon. As might be expected, there is at this stage of research no clear consensus among psychologists about comprehension processes. Rather, they are investigating a variety of theories, any one (or more) of which may ultimately prove to be a viable account of aspects of comprehension and several of which can already be "mined" for instructional implications. Our strategy in this report is to explore the implication of one broadly stated theory of comprehension, intending the exploration as an example of how instructional experiments might be derived from current models of language comprehension.

The view we chose to focus on holds that comprehension is the process of searching for, and discovering in memory or in the surrounding environment, a schema (model, hypothesis, conceptualization, frame) that accounts for the situation to be understood. When we say that a schema "fits" or "accounts for" a situation, we mean that the situation is taken to be an instance of a more general concept represented by the schema. Pursuing this view of comprehension brings the topic of reading comprehension directly into a mainstream of current psychological research interests. It unifies the problem of reading comprehension with the more general problem of comprehending the world. We can immediately mine results, discovered by cognitive psychologists with regard to these more general considerations, for their implications for our present specific interest in reading comprehension.

In order to develop this approach of applying a particular current theory of language processing we shall follow three steps we think would be essential in any application of existing theory. We shall (1) describe the theory briefly but in sufficient detail to direct it toward specific instructional applications; (2) give evidence for the scientific soundness of the approach; and (3) discuss implications of the theory for the teaching of reading comprehension.

The Theory: Comprehension as a Process of Schema Fitting

What is a schema? The term schema is used here in the sense in which Bartlett used it. The terms model, hypothesis, conceptualization and frame have all been used by different writers for the same concept.

We can consider a schema to be an abstracted concept of an object or situation. Thus, our schema for a concept like "room" would include the notion that it had four walls, a floor and ceiling, was part of a building, etc. Schemas for situations are perhaps more frequent. Thus, when we hear the sentence (Collins and Quillian, 1972), "The policeman held up his hand and stopped the cars," we bring forth from memory a schema in which a traffic officer signals to car drivers to stop and they obey, rather than the schema that we might bring forth in the case of superman, in which we might see him physically keeping the cars from moving.

Bransford and his co-workers have some interesting illustrations of the application of schemas at the level of paragraph length texts. The following example from Bransford and Johnson (1973) makes the point.

> The procedure is actually quite simple. First you arrange things into different groups. Of course one pile may be sufficient depending on how much there is to do. If you have to go somewhere else due to lack of facilities, that is the next step, otherwise you are pretty well set. It is important not to overdo things. That is, it is better to do too few things at once than too many. In the short run this may not seem important but complications can easily arise. A mistake can be expensive as well. At first the whole procedure will seem complicated. Soon however, it will become just another facet of life. It is difficult to foresee any end to the necessity for this task in the immediate future, but then one never can tell. After the procedure is completed, one arranges the materials into different groups again. Then they can be put into their appropriate places. Eventually they will be used once more and the whole cycle will then be repeated. However, that is part of life.

Without additional context, the above passage may be difficult to comprehend. However, when one is directed toward an appropriate context (a laundromat) we immediately perceive an explanatory schema (that of washing clothes) which allows us to interpret the passage. Incidently, it is important to note that there is not just one appropriate schema for a passage such as this. For example, it has been pointed out that a schema about a day in the life of a bureaucrat may fit almost as well and thereby make the passage comprehensible.

It is clear that the notion of schema remains somewhat vague. Many workers in the fields of cognitive psychology and artificial intelligence have been working on more precise notions of schemata. At this more precise level, opinions of the various workers begin to diverge. Nevertheless, as we hope to illustrate below, the notion as presented here is sufficiently precise to yield a variety of implications for teaching reading comprehension.

What does it mean for a schema to "fit"? The idea of what it means for a schema to fit or account for a passage can be rigorously specified only in the context of the various more specific interpretations of schemata. Nevertheless, we can easily give an intuitive appreciation for the idea. Roughly speaking, a schema accounts for a passage whenever the situation described can be said to be an instance of the schema. Thus we can argue that the passage given above is fit by a clothes-washing schema, but not, say by a car-driving schema. We can show that washing clothes fits by pointing to interpretations of the various "things" referred to in the passage and showing how they are associated by referents in the clothes-washing schema. Thus, the things we arrange in piles are clothes, the facilities we refer to include a washing machine and perhaps a dryer. The procedure has to be repeated after the clothes are "used" and thereby made dirty again. We overdo things by putting too many clothes in the washer at a time, and so on. Similarly, in the case of the bureaucrat, the piles might be piles of paper.

An important point along these lines is the notion of "goodness of fit." It may well be that no schema we can think of accounts for all aspects of the passage. Here Simon's principle of "satisficing" is important. We only require that a schema account well enough for the passage at hand. "Well enough" clearly must take into account the purposes for which we are reading the passage. Related to the principle of satisficing is the idea of levels of comprehension, and level of specificity of the schema to be fitted. Depending on our purpose in reading or on our degree of knowledge about the topic under consideration we can get a more or less specific understanding of the passage. Thus, for example, we might for some purposes or at some times be satisfied that a particular passage portrayed a conflict between two people. Having made this interpretation, we know there are a number of facts about their relationship. These facts may be sufficient for our purpose and we could be said to understand the passage at some level. On the other hand, it might be that the passage represented a case of extortion. If we were to interpret the passage in terms of an extortion schema, we would have a more complete set of inferences that we could make and would be said to have comprehended the passage more completely.

How does a reader discover a schema appropriate for a particular passage? This question is perhaps the most difficult to be addressed and also the most important, with respect to implications for teaching. Different theorists with slightly different representations of schemata have somewhat different hypotheses about how appropriate schemata are discovered. Perhaps the most important agreed-upon characteristic of this process is its sensitivity to local contextual factors and prior expectations, or "sets." The same passage can receive quite contradictory interpretations depending on the context in which we read it. Thus, when a person is unable to comprehend a passage, the techniques developed in the problem-solving literature for "breaking set," or viewing the passage in a new way, may be equally important in reading comprehension. Another characteristic of the process of finding a schema is its apparent general-to-specific character. It appears that we first get a general

schema for interpretation and then, to the degree that it seems important, we discover increasingly specific schemata consistent with the to-be-interpreted passage or situation. This characteristic may have implications for the time and effort a reader ought to spend reading a certain passage.

The Scientific Evidence for this Approach to Comprehension

The view of comprehension as the match or fit between the thing to be comprehended and the schemata of cognitive structure is a position that is manifested in many aspects of theorizing in psychology. It is, for example, close to the classic Herbartian concept of apperception that influenced educational thought at the end of the last century. It is also identical with the Piagetian ideas of assimilation and accommodation: comprehension is the assimilation of the thing to be comprehended into the schema, or the match or fit between the thing and the schema, and accommodation is the inevitable and necessary change that takes place in the structure of the schema as a result of the assimilation. The idea of schema fitting is also found in the concept of an "explanation" in the philosophy of science, in which something is taken to be explained when it can be shown that it is an instance of a general proposition or statement. Ausubel's analysis of meaningful and rote learning also embodies this viewpoint in stating that for learning to be meaningful, it must involve the subsumption or incorporation of the thing to be learned into some general structure or scheme, viz. the "organizer."

There is also a growing body of evidence and opinion within both information-processing psychology and artificial intelligence that the process described above is the essential component of comprehension tasks. A catalogue of the evidence would be extensive, and quickly outdated. For detailed discussions of past and potential future basic research in this area we urge the reader to look at Panel reports 1, 2, and 4 in this series.

Instructional Implications of the Model

Since the processes of comprehension proceed so quickly and unobstrusively when they go well, a fruitful method for determining the instructional implications of the schema comprehension model is to consider failures of comprehension and the possible reasons for them. When failures occur, it is possible to examine their causes and then to consider how instruction might be matched to the potential sources of difficulty. We have identified three reasons for failure to comprehend, each of which suggests certain approaches to instruction.

- The reader may lack an appropriate schema for the interpretation of some passage.

- The reader may not be able to access an appropriate schema even though such a schema may be available in his long-term memory.

- The material may be incomprehensible. There may be no single schema that will account for the material.

Each of these situations may lead the reader to be satisfied with comprehension at the wrong level of analysis or to feel that comprehension of the material is not worth the effort involved. Each may also serve as the organizing framework for important programs of instructional research.

Program 6.1.1: Development of schemas or structures for comprehension.

If a major cause of comprehension difficulty lies in the lack of an appropriate schema to account for the new material to be assimilated, the instructional approaches suggested will serve to help the individual develop appropriate schemas. We should base instructional approaches of this kind on analyses of relevant subject-matter domains so that the structures and knowledge chosen for attention will be important and generalizable. This method will require analysis of the relationships between structure and content of academic disciplines as organized for expert use and the structures that will be most useful in helping newcomers to a field acquire its important concepts. Paul Johnson's work on the psychological structure of Newtonian mechanics offers one example of how such analyses might proceed. We should encourage similar analyses for other disciplines. One aspect of such analyses, particularly involving instruction for younger children, is the mapping of naturally acquired or developing structures to those of the disciplines. Finally, in addition to analysis of knowledge structures for purposes of organizing instruction, it will be important to explore alternative approaches to communicating these structures. At one extreme lie informal approaches, in which new knowledge is acquired through relatively unstructured reading, conversation, and related experiences. At the other extreme are approaches in which particularly powerful organizing structures are taught directly and didactically. As in most instructional work, it is unlikely that either of the extreme approaches in their purest forms will prove optimal; rather, empirical investigations will be required to develop optimal approaches to the problem of providing organizing schemas where they are absent from readers' repertoires. Finally it might be possible to design diagnostic instruments for teachers and evaluators to use to determine the kinds of schemas that students possess or lack.

Program 6.1.2: Teaching of strategies for accessing comprehension schemas.

Much of what appears behaviorally as failure to comprehend can probably be attributed to a failure to access appropriate schemas, even when the individual has them available in memory. This probability suggests a search for teachable procedures and techniques that a reader who has failed

to comprehend can employ to remedy the situation. The task is to discover these strategies and to invent procedures for teaching them. Applicable strategies may very well be applications or extensions of traditional problem solving heuristics and algorithms, and may also represent a refinement and further development of the "study skills" literature. One way of viewing the comprehension strategies we envisage is to think of them as "second trial" procedures for reducing incomprehensibility. Teachers have used many such procedures for many years, but they are not widely or systematically taught, nor are they typically taught as generalized strategies for managing one's own learning. Examples of strategies could be as simple as rereading or looking up words, or could build on other strategies such as self-questioning, analysis of part-by-part expectations, brainstorming, writing precis, syntactic and semantic substitutions, or attempts to explain comprehended parts of a text in the course of conversation.

Demonstration of the effectiveness of these strategies for comprehension and development of assessment instruments to determine their appropriateness would set the stage for instructional research to seek the best methods of teaching them. Some may need only prompting, others may be learned best via modeling procedures and still others may require drill and overlearning to reach the point of "automaticity," where they are called upon easily and appropriately to the context. Since some of the effective "second trial" strategies may operate naturally in normal comprehension, an analysis of their untutored functioning is important to this general effort.

Program 6.1.3: Optimal organization of text for comprehension.

This strategy is a corollary of the preceding ones. It focuses not upon the cognitive structure the individual brings to the text, but upon the structure that the text supplies for the individual. Not all texts are well-written--at least not for all readers. Substantial improvements in reading may be expected as a result of a form of "engineering" that increases the comprehensibility of widely read texts by making the schemas they embody more explicit and more suitable to the expected development level of the target reader population. This strategy is potentially powerful in that we have more control over the structure of text than we do over the structure of the mind. Thus, we can manipulate aspects of text to facilitate comprehension. One could view the approach as an extension of that part of the prose learning and study skill literature that is focused on features of text (or additions to text) which increase mastery, retention, and transfer. It requires the analysis of text structure and its constituents to identify crucial elements of comprehensibility. One result of such an analysis should be the gradual development of a normative "grammar" of prose or connected discourse that is capable of guiding writing intended for instructional purposes.

APPROACH 6.2

INSTRUCTIONAL PRACTICE AS THE SOURCE OF INSTRUCTIONAL DESIGN AND THEORETICAL MODEL BUILDING

An examination of educational innovation and change suggests that successful instructional practices, even though not grounded in theoretical statements and empirical research, merit investigation. Many educators are working in ways that seem to be effective, though they are not necessarily able to state why their methods work or to articulate a corresponding theory. Through examination, extrapolation, and augmentation of teaching practices related to comprehension, we can seek to formulate a set of principles by which we can derive a variety of specific teaching techniques and organize existing ones.

It is clear that one of the major problems of this approach relates to the designation of that which is considered to be successful. Many practices, however, appear to have a face validity, in that learning takes place and educators acclaim the technique. This approach is based in reality insofar as it speaks to the immediate needs of teachers, and validates their most promising work. It offers the potential for a working partnership between scholars and practitioners and has practical implications with regard to the dissemination of the outcomes. By addressing the relationship between ongoing practices and comprehension processes, we may discover underlying principles which facilitate the development of other successful practices. Perhaps the greatest value of the approach is that it puts into the hands of educators the principles with which to generate further successful practices.

No general theoretical framework for the approach appears to exist, although it seems to be related to Heider's "naive psychology." There are increasing numbers of interventions in schools, mainly in the elementary grades, which seek to promote and disseminate effective practice related to the growth of "understanding," but such interventions have not been characterized by vigorous attempts to generate and specify the underlying theory. In consequence, we are now at the point where the lack of sound theoretical bases is beginning to inhibit further progress. We should stress that sound methodologies for producing such frameworks may be difficult to achieve. Nevertheless, the urgent need to discover what makes effective practices successful, and to embody such discoveries in forms which will enable both evaluation of present practice and generation of new tasks to take place, constitutes the rationale for this approach.

Three kinds of research programs are proposed here. The first is concerned with identifying <u>general</u> dimensions of successful teaching practices and with establishing principles which may be used to generate new practices.

This program seems crucial to the production of a set of guidelines to further effective instruction.

The second program involves exploring the implications of specific practices already identified which appear to have had considerable success and which promise further success if well understood and more widely used. These practices, used here as examples, include: (a) techniques aiming to improve comprehension by mediating desired outcomes; (b) techniques relating to readers' monitoring their own comprehension processes; (c) techniques which selectively widen the knowledge base of readers. The second and third areas of investigation, drawn from a consideration of practice, match those derived from language comprehension theory. We will discuss them from a slightly different vantage point here. However, we view their emergence from two distinctly different sources as encouraging indicators of the kind of convergence on instructional improvement that we can expect from the three general approaches proposed by this panel.

The third program relates to the use of "hardware." Computers and other media are becoming increasingly available to educators, and we should investigate their potential for teaching reading comprehension.

Program 6.2.1: Identifying dimensions of successful reading comprehension instruction.

The aim of this program is twofold: First, we need to investigate the nature of successful practice in an attempt to articulate those variables critical to learning for students at varying developmental and attainment levels. Second, we need to arrive at a set of principles and prescriptions for generating new instructional procedures. Knowledge of the characteristics of successful reading comprehension teaching techniques would have wide applicability in relation to curriculum design.

Several decades of research on teacher behavior and classroom practice reveal how difficult it is to relate critical variables to outcomes. Various methodologies exist which may have some application to the program, but we expect that research will contribute to methodological as well as substantive knowledge. Interaction analysis may be applicable, and methods used in survey research and the related social sciences may also be appropriate.

We have identified four interdependent components of a general program concerned with identifying critical variables in successful reading comprehension instruction. The first is specification of behaviors, attitudes, and beliefs of the teachers, together with a description of relevant personal and professional qualities. From the specification and description, the goal is to characterize the nature of the significant variables in the effective teaching of reading comprehension. We suggest that a number of methodological approaches will need to be employed, including interviewing, observation, and a consideration of the relationship between self-reports

and observational data. Contrasts of successful and unsuccessful practitioners are at the heart of such a study, and we must develop and apply methods for attributing success or failure to various instructional practices.

The second component is examination of the nature of the instructional practices and their contexts. We must generate ways to categorize the various kinds of practice and their contexts. We must also find methods of evaluating the degree of effectiveness and "fit" between activity and learner. The examination must also consider the relationship between observed and claimed practices in relation to outcomes. Research has shown that there is a low correlation between what people say they do and what actually happens.

The third component is specification of those critical variables which relate to the generation and transfer of effective practices as a result of experimentation involving the manipulable variables. The fourth component is specification of those manipulable variables to aspects of reading comprehension, thus establishing a basis upon which we can build effective practices.

Program 6.2.2: Investigation of specific practices that now appear successful.

This program involves three sets of activities. The first involves the study of situations where reading comprehension is the mediator of desired action. The work is addressed in part to the problem of motivation for reading. It does so by exploring reading comprehension instruction techniques that require students to comprehend written forms as an essential prerequisite to the achievement of an act that they wish to accomplish. The research proposed here is intended to establish environments to maximize these effects and explicitly to relate such environments to basic reading comprehension processes.

This research is clearly related to what is sometimes called "contingency management" in that a desired outcome is made contingent upon comprehending what one reads. However, the "desired outcome" for the child is organically tied to the reading process rather than being an externally offered reinforcement. Although the program has wide applicability, we suggest that the most likely target population will be students in the elementary grades.

To pursue this work we have identified three interdependent but separate research projects. The first is the specification of activities which, because they are related to children's interests, can serve as the motivation for reading and comprehending. The focus of this research is the delineation of those activities in school that children want to engage in, and for which it seems reasonable to make reading a necessity. The research should show how many of the actions which elementary students perform in school can be related to the growth of reading comprehension without the need for major reorganization in the classroom.

The second project would investigate the limitations and conditions required to implement the basic plan of using reading as a mediator of the desired outcomes. This includes consideration and investigation of the complexity of intervention strategies, attentional tolerances, and the uses of both human and material resources, i.e., student-student interaction, student-adult interaction, student-materials interaction. One important outcome of this project will be guidelines teachers can use to shape activities within the existing school structure, although some reallocation of time and organizational priorities and emphases may be required.

The third project is concerned with the development of action-output tasks which are not only effective but related precisely to basic reading comprehension processes. Activities of many kinds leading to action are relatively easy to design at the elementary school level, and it is expected that the set generated will relate to a number of basic reading comprehension processes. One should not, however, expect that every aspect of comprehension can be matched.

Another set of research activities involves the examination of techniques for teaching self-conscious application of comprehension strategies. We often make the assumption that good readers employ certain strategies, depending on the nature of the text to be comprehended, and that readers are implicitly aware of their use. The aim of this research effort is to examine the effect on comprehension of making these strategies explicit to the reader and to relate them to basic reading comprehension processes. If readers can monitor their own comprehension performance, they should be far better equipped to comprehend any written material.

This research is related to the emergent field of "metacognition." It focuses on individuals' sense of what they are doing while they are doing it. Two research projects should be carried out. The first is the description of strategies for self-monitoring reading comprehension and the relationship of these strategies to specific reading comprehension processes. The research would also have to consider the degree to which students can handle the self-monitoring process and under what conditions. Such conditions may lie within the realm of affective response as well as the cognitive domain. Certain kinds of reading material may be more amenable to self-monitoring strategies than others. The major value of this project lies in the transferability of self-monitoring strategies to other domains.

The second project is the elaboration of techniques for teaching identified strategies. We recognize that the degree to which students can be reflective about their own cognitive acts is dependent upon their developmental levels. This program begins to become critical in relation to learning at the junior high school level, and therefore we suggest this as the target population.

The final type of successful practice that should be explored views comprehension as a by-product of extending the child's experiential base. It seems clear that children's ability to comprehend new information is dependent upon their existing knowledge base. The goal of this program is to identify ways to extend the knowledge base which have high payoffs in terms of ability to comprehend. A further goal is to differentiate these techniques with respect to developmental and attainment levels for which they are most effective.

Many current practices attempt to widen the knowledge base in a variety of ways. The considerable increase of direct experience at the primary level and the interdisciplinary approach to subject areas at higher levels are two examples. The integration of a concern for reading comprehension can probably be made without gross changes in regard to content or practice.

Research activities in this area must be geared toward investigating such techniques in relation to specified groups of students. We expect that there are two particular target groups for which this program has particular relevance: (1) young children who have recently mastered the decoding process; (2) children in need of remedial experience at the junior high school level. With respect to younger children, the proposition, which finds expression in many classroom activities, is that an increase in the knowledge base will increase their comprehension skills. The aim of this research is to define and investigate appropriate kinds of experiential learning relating directly to the acquisition of such skills.

For older, remedial students there is often an accumulated deficit of failure in reading comprehension. A dramatic change of approach often is needed to redress this imbalance. As for young children, the aim of this research is to find ways of increasing their knowledge base so that better reading comprehension results. It is clear that motivational and environmental issues will be highly significant. We do not expect that a comprehensive, widely general set of procedures will be easily derived, but the problem is so pressing that it deserves attention even as a relatively "high-risk" or "slow-payoff" undertaking.

Program 6.2.3: The role of the computer in teaching reading comprehension.

The contribution of media other than books to the growth of literacy and reading comprehension is of extreme importance. In particular, it is essential to study the use of the computer at this time, when the instrumentation is at an advanced stage of development.

Technological advances have resulted in the availability of small inexpensive computers. Just as the miniature electronic calculator is now inexpensive enough for regular classroom work, so too, in a very few

years, may the miniature computer be available at remarkably low prices. On the face of it, it would seem that these devices could be potent teaching tools. It seems of prime importance that we investigate their potential for teaching reading comprehension.

Computer-Assisted Instruction (CAI) now has something of a bad name in scientific and educational circles. However, in our view this bias has resulted from the primary use of the computer as a sophisticated "teaching machine" (in the old sense of the word), rather than as a medium whereby the student can generate interesting events under his own control and at his own level of aspiration. We suspect that the computer, and especially small computers, will prove an n important teaching device when employed in this latter way. One example of the use of the computer in a number of interesting ways is the work of Seymour Pappert at MIT.

We feel that the computer may be an especially good method for teaching reading comprehension for a number of reasons. For example, the computer can serve as a mediator of a wide range of intrinsically interesting actions. We have in mind things ranging from the student interacting with a highly structured program, to teaching him to generate programs in existing computer languages (such as LOGO). In the computer-mode, the young child can use the reading-writing mode of communication before he has mastered the art of penmanship. Another virtue of the system is that it can give the student a wide range of experiences within a variety of symbol systems. We would expect that experience with multiple symbol systems is important to the growth of general comprehension ability. Another advantage of the computer is that it allows the teacher to provide a truly responsive environment for each student.

There are many different projects which could be considered. Each must involve the development and/or the evaluation of the use of the computer specifically for teaching reading comprehension. We suggest two projects only. Both relate to existing developments in the field, and involve children making creative use of the computer. We make the assumption that it is the process of the students' interaction with the computer that is of fundamental importance--not the facts learned as in some programmed learning procedures. Each project should result in the development of a prototype system. The first suggested project is evaluation of the potential for increasing reading comprehension of teaching the student to program in a high level language (such as "Small Talk" or SOL). The second is evaluation of the potential of using the computer as a conversant for teaching reading comprehension.

APPROACH 6.3

PSYCHOLOGICAL ANALYSIS OF READING COMPREHENSION TASKS

Despite the difficulties of educators and psychologists in defining comprehension (witness the multiple and often conflicting "taxonomies" of comprehension skills produced to help guide educational practice), there seems to exist a "common sense" notion of what it means to comprehend. Typically, this common sense definition is expressed in the form of tasks which, when carried out effectively, are taken as evidence that the individual has comprehended a message. For example, if individuals can hold a reasonably intelligent conversation about a text they have read, if they can scan the headlines to pick out key news events, if they can follow directions, if they can evaluate a text and support their evaluation, there is little doubt that they have "comprehended" a text at some socially relevant level. Most of these definitions of comprehension are recognized in school practice, although only a few are typically sampled on comprehension "tests."

In this approach we suggest taking the common sense definition of comprehension as a starting point and, through the process of task analysis, deriving both a theoretical description of comprehension processes and suggestions for relevant instructional practices. The procedure proposed defines research programs directed at both activities.

1. Generate a list of comprehension tasks individuals frequently encounter in school and outside. This list may differ according to the age, cultural interests, or educational status of the target population.

2. Analyze these tasks in psychological terms to produce: (a) a theoretical description of "comprehension" in a particular task environment; (b) an account of the subskills (strategies and processes) common to a number of different tasks.

3. Use the analyses to develop teaching techniques of two kinds: (a) direct instruction in the tasks themselves; and (b) instruction in subskills common to several tasks.

4. Build diagnostic tests of comprehension skills based on the components identified in the task analyses.

The particular value of this approach is threefold. First, starting with actual comprehension tasks assures contact with the demands of real life in school and outside. It avoids the possibility of tying instruction and research to tasks that are convenient for tests or in the laboratory, but not necessarily of practical value. Moreover, analysis in terms of the psychological constructs common to scientists in the field provides

one effective means for bringing psychology to bear on practical tasks. Finally, as a result, we can anticipate a double payoff from this task analysis approach; on the one hand, usable instructional products and techniques; on the other, advances in our theoretical understanding of the nature of comprehension.

Task analysis is a crucial intervening step that allows psychologists to bring their theories and constructs (developed in the laboratory, often using specially designed experimental tasks) to bear on the complex kinds of behavior that characterize most of our lives. Task analysis techniques of several kinds are being used increasingly among psychologists today. We can identify three levels of complexity among task analysis methods. These are exemplified in (a) hierarchy analysis in which tested sets of "prerequisites" for some target skill are identified; (b) "idealized process analysis," in which ideally efficient routines for performing a task are laid out and then used to specify instructional routines; and (c) formal information-processing analyses that attempt to describe actual performance (including typical errors) of people on specified tasks. These formal analyses are frequently, but not always, specified in the form of computer simulation programs. They are always subject to a variety of empirical validations that make full use of the range of experimental and descriptive methodologies now in general use within cognitive psychology. Thus, the task analysis approach has a number of already developed methodologies upon which to draw.

Program 6.3.1: Generation of lists of comprehension tasks for specific populations.

Different comprehension tasks are relevant in the lives of different groups of people. An important first step--although not necessarily a lengthy one--is to identify tasks that, for any given population, are the most interesting and important. Tasks can be expected to differ depending on the age of the population to be taught, their particular social situation, their cultural backgrounds, their aspirations, their current interests, and their current level of educational achievement.

In many cases educators can list the important tasks of comprehension with little need for formal research. For certain populations, however, deeper study may be required. Such study would constitute a first step in applying the task analysis approach whenever no clear consensus can be detected in a community as to what are the important comprehension tasks. The job of this kind of study is to identify the tasks considered important and useful in a given population. Social scientists (e.g., those interested in survey research) have developed a variety of sophisticated means for determining the interests, values, and opinions of groups of people. We could use these methods whenever the consensual definition of comprehension is not immediately apparent from simple inspection of people's daily activities. They are a means of generating a common sense definition of comprehension relevant to a particular population.

Program 6.3.2: Analysis of tasks.

This activity is, of course, at the heart of the approach under discussion. It is best conceived as an activity undertaken in interaction with a program of instructional design, since the results of instructional experiments can provide an important source of validation, or cause for revision, of task analyses.

Before analysis, we must address two questions: (a) what priorities should be established among the tasks, and (b) what method should be selected for the analysis.

Establishing task priorities. As indicated earlier, the tasks subjected to analysis should be chosen from among those which are consensually recognized as involving comprehension in the real world. While task analyses can be performed for any tasks, it seems reasonable to begin with tasks that meet two criteria: (a) those which will result in the highest practical payoff, i.e., those that are called upon frequently in in school and outside and (b) those whose analysis will most readily use the tools and methodologies presently available to psychologists.

Selecting a methodology. The methodology selected should be the least costly form of analysis (particularly in terms of time) that will yield usable results. It seems doubtful that hierarchy analysis is likely to prove useful in the domain of comprehension, since comprehension involves a complex interplay of strategies and processes that are not easily observable and may not be organized into strictly ordered acquisition sequences. Idealized task analyses may provide a useful start, particularly for tasks in which a very clear criterion of "success" is available. In most cases, however, we believe that formal information-processing analyses, together with empirical validation and study, will be required if progress is to be made toward understanding what people do when they comprehend. It is precisely such understanding that the present approach suggests is necessary for major advances in instruction in comprehension to take place.

Although the cost of formal analysis is high, research methodologies already exist and are in increasing use among psychologists. Languages and facilities for computer simulations are becoming more widespread; methods of analyzing and interpreting protocols, reaction times, eye movements, etc. are becoming increasingly sophisticated. In addition, candidate or partial analyses of many tasks already exist, drawn in part from recent work in the field of artificial intelligence (AI). While AI programs do not accept the constraint of matching human performance, they do provide models of heuristic language understanding which may be useful starting points for instructionally relevant task analysis. Thus, for example, programs such as STUDENT, which translates arithmetic "story problems" into algebraic equations, or SCHOLAR, which allows a natural language "conversation" between a human being and a computer on a particular topic, may provide important elements for the analyses of human performance that is sought in the present approach. The important point

is that task analysis is going on throughout psychology and related disciplines at the present time. It does not need to be invented for instructional purposes; rather it needs to be selectively and intelligently applied to tasks of instructional interest.

Program 6.3.3: Development of teaching techniques.

Two sets of activities in this area need to be addressed. The first is the formulation of strategies for the teaching of subskills (strategies and processes) common to a number of tasks. To the extent that one calls upon a limited number of subskills in a large number of comprehension tasks, there exists the possibility of highly efficient instruction by teaching those subskills. The teaching of strategies and processes which are elements of comprehension is a relatively new venture. Considerable ingenuity will be needed on the part of the researcher who attempts to carry out this type of program. Multiple failures may precede success, and heuristic judgment will be necessary to decide when to proceed and when to change direction. This work is valuable to the extent that there is transfer from the subskills to performance on the real-world tasks. Assessment of this transfer should constitute an integral part of research of this kind.

A second set of teaching strategies to develop are those involving direct instruction in comprehension tasks. One outgrowth of task analyses should be development of teaching techniques resulting in direct instruction in the tasks themselves. This kind of teaching insures relevance to real comprehension demands. However, it may sacrifice some generalized capacity in favor of immediate payoff. This question should be addressed empirically.

Priority ordering of the tasks to be taught would be required. This ordering would involve a balancing of perceived social need with the ease of instructability for the population in question. Extensive practice in the performance of a particular task is likely to be a major teaching technique. Systematic criteria for sequencing the practice exercises will need to be developed, using the task analyses as the basis.

Program 6.3.4: Development of tests of comprehension based on task analyses.

This proposed research program involves developing tests which can be used in diagnosing specific difficulties in comprehension. It thereby will assist in matching instruction to individual need. Task analysis provides a basis for developing diagnostic tests that help to determine which specific subskills cause difficulties for an individual in the course of a comprehension task. Unlike the usual standardized tests, diagnostic tests of this kind can provide a basis for instructional intervention addressed to particular strengths and weaknesses of the individual.

Considerable work has been done on the methodology for developing diagnostic ("criterion-referenced") tests of this kind; most recently attention has begun to be directed to problems of validation where the predictive criteria used in standardized (norm-referenced) test construction is inapplicable. Work on this program can therefore draw on an increasingly sophisticated methodology already in existence.

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